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(21) International Application Number: PCT/GB99/00835 (22) International Filing Date: 18 March 1999 (18.03.99) (30) Priority Data: 9805824.1 18 March 1998 (18.03.98) GB (71) Applicant (for all designated States except US): FLYING NULL LIMITED [GB/GB]; Harston Mill, Harston, Cambridge CB2 5NH (GB). (72) Inventors; and (75) Inventors/Applicants (for US only): CROSSFIELD, Michael, David [GB/GB]; Perne Drift, Burton End, West Wickham, Cambridge CB1 6SD (GB). ARNOLD, David, Howard [GB/GB]; 20 Pine Grove, Weybridge, Surrey KT13 9AW (GB). (74) Agent: ABRAMS, Michael, John; Haseltine Lake & Co., Imperial House, 15-19 Kingsway, London WC2B 6UD (GB).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: MAGNETIC PATTERNS (57) Abstract This invention relates to a document which incorporates (1) a magnetic watermark and (2) a further magnetic material which is magnetically anisotropic and is in proximity to the magnetic watermark, said further magnetic material being in the form of a continuous layer of a metallic material having a coercivity of 10 Oersted or less.		

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MAGNETIC PATTERNS

This invention relates to the exploitation of magnetic patterns in a range of practical techniques, in particular (but not exclusively) for security documents and the like, and utilises a new technique of spatial magnetic interrogation in conjunction with a magnetic marker or identification tag.

10 In previous patent applications, in particular PCT/GB96/00823 (WO 96/31790) and PCT/GB96/00367 (WO 97/04338), we have described and claimed novel techniques for spatial magnetic interrogation and novel tags. The technology described in WO 96/31790 is based
15 on exploiting the behaviour of magnetic materials as they pass through a region of space containing a magnetic null. In particular, these earlier applications describe, inter alia, how passive tags containing one or more magnetic elements can perform as
20 remotely-readable data carriers, the number and spatial arrangement of the elements representing information.

In the above applications we described a number of possible system embodiments employing either permanent
25 magnets or electromagnets to create the magnetic null. We also described several system implementations some of which are particularly appropriate for tags employing very low coercivity, high permeability magnetic elements. These implementations work by
30 detecting harmonics of a superimposed low-amplitude alternating interrogation field.

In a later application, GB9612831.9, and its successor PCT/GB97/01662 (WO97/48990), we describe arrangements
35 which work by detecting the baseband signals generated by the passage of the tag through the magnetic null,

without the need for any superimposed alternating interrogation field. Specific designs for readers are described in PCT/GB97/02772. The content of these above-mentioned patent applications (hereinafter termed

5 "the prior FN applications) is incorporated herein by reference thereto.

The present invention utilises techniques and materials such as described in the prior FN applications, or

10 components of such techniques and materials, in conjunction with the known technique of magnetic watermarking (termed simply "watermarking" hereinafter).

15 Watermarking is based upon the formation, within a document, of a permanent magnetically readable element formed (e.g. by deposition) of magnetisable particles of predetermined shape (e.g. acicular) in a predetermined orientation or in several spaced

20 orientations. Thus certain regions within the magnetic material may have zones comprising acicular magnetic particles aligned in one given direction; and other zones comprising acicular magnetic particles aligned in another given direction; and yet other zones comprising

25 acicular magnetic particles in random orientations. In this way, a variety of magnetic patterns may be generated. These patterns can represent information which, by virtue of the watermark being incorporated into the document during its manufacture, can be

30 regarded as quasi-permanent. Watermarking is described, for example, in British Patent Specifications Nos. 1,331,604; 1,519,142; 1,529,937; 1,529,938 and 1,529,939.

35 GB 1,529,938 describes a magnetic recording medium in which the magnetic watermark layer has, overlying it, a

second magnetic layer which comprises a magnetically anisotropic material, the easy axis of magnetisation of which has a permanent predominant alignment. As disclosed, the overlying layer consists of magnetic particles, e.g. gamma-Fe₂O₃ particles, in a binder; the coercivity of this material is preferably 200-250 Oersted. The easy axis of magnetisation of the overlying layer is preferably perpendicular to that or those of regions making up the watermark layer.

10

We have now found, surprisingly, that if a document containing a magnetic watermark has, in addition, a layer (or at least regions of) a further magnetic material of low coercivity deposited over the watermark, either during the manufacture of the watermark or afterwards, the composite magnetic structure may be susceptible to interrogation in the manner proposed in the prior FN applications.

Accordingly, the present invention provides a document which incorporates (1) a magnetic watermark and (2) a further magnetically anisotropic material in proximity to the magnetic watermark, said further magnetic material being in the form of a continuous layer of a metallic material having a coercivity of 10 Oersted or less.

Said further magnetic material is advantageously a thin film magnetic material. Preferably, the continuous layer of magnetic material is not more than 10 microns in thickness, and more preferably is not more than one micron in thickness. The coercivity of said further magnetic material is preferably less than 2 Oersted, and typically will be in the range of 0.1 to 1.0 Oersted.

Said further magnetic material may be an amorphous metal glass or a magnetic alloy, e.g. permalloy.

- The further magnetic has low coercivity - i.e. is a soft magnetic material. Additionally, it is anisotropic, and possesses an easy axis of magnetisation. This may be a shape-dependant property and/or a material dependant property.
- 10 Preferably, the document of this invention incorporate a magnetic watermark which is overlaid with a layer of a soft magnetic material such as is currently used in magnetic EAS tags. This will generally be a thin film material which can easily be magnetised along one axis,
- 15 e.g. its major axis, but which cannot effectively be magnetised in a direction through the thickness of the material. Such a material may be deposited directly over the magnetic watermark or there may be intervening material between the two. Also, the further magnetic
- 20 material may be coextensive with the watermark; or it may be smaller than, but contained wholly with the area of, the watermark; or it may have a part which is superjacent with respect to the watermark and another part which lies outside the area of the watermark.
- 25 A document in accordance with this invention may be a security document, e.g. a banknote, cheque, bond, credit card, share certificate or security key.

CLAIMS:

1. A document which incorporates (1) a magnetic watermark and (2) a further magnetic material which is magnetically anisotropic and is in proximity to the magnetic watermark, said further magnetic material being in the form of a continuous layer of a metallic material having a coercivity of 10 Oersted or less.
2. A document as claimed in claim 1, wherein said further magnetic material is a thin film magnetic material.
3. A document as claimed in claim 1 or 2, wherein said continuous layer of magnetic material is not more than 10 microns in thickness.
4. A document as claimed in claim 3, wherein said continuous layer of magnetic material is not more than one micron in thickness.
5. A document as claimed in claim 1, 2, 3 or 4, wherein said further magnetic material has a coercivity of less than 2 Oersted.
6. A document as claimed in claim 5, wherein said further magnetic material has a coercivity in the range of 0.1 to 1.0 Oersted.
7. A document as claimed in any preceding claim, wherein said further magnetic material is an amorphous metal glass.
8. A document as claimed in any one of claims 1 to 6, wherein said further magnetic material is permalloy.

9. A document as claimed in any preceding claim, wherein the document is a banknote, cheque, bond, credit card, share certificate or security key.
- 5 10. A document as claimed in any preceding claim, wherein said further magnetic material overlies said magnetic watermark.

INTERNATIONAL SEARCH REPORT

Int. Application No
PCT/GB 99/00835

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06K19/06 G01V15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G06K G01V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 1 529 938 A (EMI LTD) 25 October 1978 (1978-10-25) cited in the application column 3, line 2 - line 50; figure 1 ---	1,9,10
A	WO 97 04338 A (SCIENT GENERICS LTD ;DAMES ANDREW NICHOLAS (GB); CROSSFIELD MICHAEL) 6 February 1997 (1997-02-06) cited in the application page 3, line 12 - line 26; figure 1 -----	1-4,7-9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

9 July 1999

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16/07/1999

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Int Application No
PCT/GB 99/00835

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1529938 A	25-10-1978	NONE	
WO 9704338 A	06-02-1997	AU 4725096 A	18-02-1997
		CA 2227170 A	06-02-1997
		CN 1193388 A	16-09-1998
		EP 0839330 A	06-05-1998